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# DESIGN OF LOW COST SEMI-AUTOMATIC DRY IRONING MACHINE FOR LAUNDRIES

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***ABSTRACT***

***In most of the laundries, manual ironing machine is used. This leads to more efforts for the ironing process as this manual ironing machine is designed for low utilization (i.e. ironing of few clothes). The manual work increases the human fatigue which causes the pains in joints. This drawback can be reduced by using semi-automatic process/machine. In this work, a semi-automatic ironing machine is designed for laundries work which will reduce human fatigue.***

***KEYWORDS: Strip Heaters, Soleplate, Cam and Follower Mechanism, Table & Energy Regulator***

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Original Article

## INTRODUCTION

Ironing or smoothing is the work of using a heated tool to remove wrinkles from fabric. The most popular way of ironing is by using an electric iron. There are some features in a modern electrical iron such as a thermostat, electrical cord, cord control and energy-saving control. Due to these features, the cost of electric iron has increased.

Ironing works by loosening the bonds between the long-chain polymer molecules in the fibers of the material. While the molecules are hot, the fibers are straightened by the weight of the iron, and they hold their new shape as they cool. Some fabrics, such as cotton, require the addition of water to loosen the intermolecular bonds. Many modern fabrics (developed in or after the mid-twentieth century) are advertised as needing little or no ironing. Ironing may also be used as a germ/parasite killing hygienic operation.

## LITERATURE REVIEW

**B. Hemalatha et al. [2014]** developed an innovative framework and motorized mechanisms to effectively iron various clothes by minimizing the difficulties in the task of ironing. Here two irons were used to increase the effectiveness and speed of ironing as well as reduce the overall time taken for one cloth (by ironing it from both sides i.e. up & down simultaneously). The cloth will be mounted on a stationary frame between the two irons. The movement of these irons is based upon chain & sprocket mechanism governed by only two motors (X & Y direction each). For designer clothes and all other different varieties of clothes that will not be ironed by automatic ironing machine, a special feature has been given i.e. the upper iron can be completely detached off from the setup and can be used as our usual house-hold iron.

Provision for long clothes like saris, bed-sheets etc. are also provided. It will be a very beneficial product for hospitals, railways, hotels, housing societies, textile mills and to the working population around the world.


**Figure 1: Chain and Sprocket Mechanism.**

**Low Ko Wee [2010]** developed electric iron to support and enhance the psychological aspect of the user and the environmental sustainability aspect when using the electric iron. Psychological aspect, in this case, means to let user gain self-confidence and less worried about their safety when using the electric iron. Environmental sustainability means how wasted heat energy of the iron could be renewed.

**Figure 2: Modified Electric Iron.**

They showed the design process for designing the user interface and the industrial design of the electric iron and how these two areas could be merged seamlessly using the same design language, design elements and strategies.

**Aghanwa Sunny et al.** [2014] designed a low-cost stainless steel iron for the fabrication of the chambers and aluminium was used to fabricate the base of the pressing iron.

**Figure 3: Gas Pressing Iron.**

Testing was carried out on various materials such as nylon, cotton, silk etc. and the temperature for pressing these materials were recorded.

**Tholsee Naidoo [1991]** developed a machine for automatically ironing garments or other articles which are conveyed through the machine on hangers. The machine comprises an ironing zone to receive an article to be ironed and a

heat applying means for applying heat to an article received at the ironing zone. The heat applying means is mounted on a shuttle which is movable relative to the ironing zone for traversing that zone. The heat applying means include two opposed heat applying surfaces one disposed on each side of the ironing zone for contacting a surface of an article at the ironing zone and conforming to the surface contour thereof while traversing the ironing zone.

**F. D. Sohne [1980]** developed a roller or cylinder, the surface of which is spirally grooved to form depressions which carry air to the fabric being pressed. The pressing-surfaces are divergent from the centre of the cylinder, in order to, effect stretching of the fabric during the pressing operation.

This invention is to provide the machine for the calendaring or smoothing of collars, cuffs, and other laundry work. The machine is also applicable for the ordinary purposes of calenders as now commonly employed.

## REVIEW OF EXISTING METHODS

Various ironing machines with their specification and price are listed below:

**Table 1: Existing Methods**

| Name | Image | Price (Rs) | Ironing Time (min.) |
|---|---|---|---|
| Automatic Steam Ironing Machine |  | 75000 | 5 |
| **Semi Automatic Press Ironing Machine** |  | 45000 | 4 |
| **Fully Automatic Shirt Ironing Machine** |  | 1450000 | 3 |
| Automatic Effie Ironing Machine |  | 64000 | 2 |
| Garment Steamer |  | 4500 | 3 |

**Automatic Steam Ironing Machine**

With the help of steam heating effect, the wrinkles are removed with some manual effort.

**Semi-Automatic Press Ironing Machine**

- The ironing machine is known for their most far-fetched quality and stunning finishing at the sensible cost in the stimulate time era.
- This ironing machine uses steam to remove wrinkles or to smother the clothes.

**Fully Automatic Shirt Ironing Machine**

- It is controlled by touch screen PLC; it is easy to operate.
- All heating models are made of mirror-polished stainless steel, it will never rust.

**Automatic Effie Ironing Machine**

- We can hang up to 12 different items of clothing to be ironed.
- After pressing the start button Effie will do the rest of work.
- Then finally we have to collect the ironed clothes.

**Garment Steamer**

In garment steamer, the clothes or fabrics that are to be press needs to be put on the statue and then by using the steam the wrinkles can be removed with the help of a steam gun.

**Need of Semi-Automatic Dry Ironing Machine**

In most of the laundries, dry ironing machine is used. This ironing machine is designed for household application (less utilization). The same is being used by laundries daily continuously. The person has to move his hands back and forth which leads to fatigue and reduces human comfort. Also, the time required for ironing is more. The main objective of this project is:

- To reduce the human efforts required for ironing the clothes.
- To reduce the time required for ironing clothes.

**Proposed Model of Low-Cost Semi-Automatic Ironing Machine**

Below figure shows the proposed model of low-cost semi-automatic dry ironing machine as shown modelled in CATIA and each part number is labelled below:

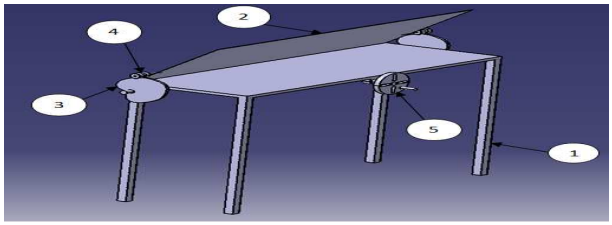


**Figure 4: Proposed Model in CATIA.**

The table below shows the part number and part name:

**Table 2: Part List**

| Part Number | Part Name | Quantity |
|---|---|---|
| 1 | Table | 1 |
| 2 | Sole Plate | 1 |
| 3 | Cam | 2 |
| 4 | Roller Follower | 2 |
| 5 | Handle | 1 |

### Construction

Low-cost semi-automatic ironing machine consists of table, soleplate, bevel gear, cam and roller follower mechanism and handles used to control the movement of soleplate through bevel gear followed by a cam and follower mechanism as shown in figure 4. The strip heaters are mounted on the top surface of the soleplate.

### Working

When the handle is rotated the movement is transferred to the bevel gear. The bevel gears are positioned at an angle of $90^{O}$. The motion is then transferred to the cam which is always in contact with the roller follower attached to the soleplate as shown in figure 4. The two cams at both ends provides the necessary lift according to the profile which is always in contact with the slot provided in roller follower.

## DESIGN/SELECTION OF VARIOUS ELEMENTS

### Design of Table

The table is used as the base for keeping the clothes to be ironed. The table is designed by considering the ergonomics consideration and flexibility of the human body. Specifications of the table are given below:

Area = $1200 \times 400$ $mm^2$

Height of Table = 850 mm

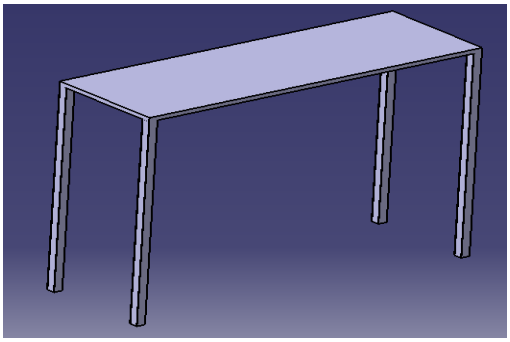

**Figure 5: Table.**

### Selection of Soleplate

In most cases of ironing machine, aluminium and stainless steel are used as soleplate. In this case, stainless steel is used as soleplate.

Soleplate is made of stainless steel material that comes in direct contact with the clothes to be pressed to remove the wrinkles from it.

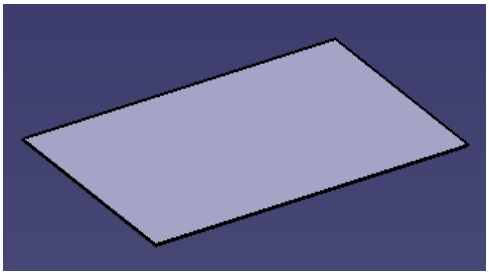

**Figure 6: Soleplate.**

The dimensions of soleplate are selected according to the standard maximum size of the cloth according to the human body.

Specification of Sole Plate:

Length = 1200mm

Width = 400 mm

Thickness = 2 mm

Steel Plate Area = length × width

= 1.2 × 0.4

= 0.48 $m^2$

Volume = area × thickness

= 0.48 ×0.002

= 0.00096 $m^2$

Weight of Sole Plate = volume × density

= 0.00096 ×7900

= 7.58 Kg

The heat generated in a plate can be obtained as follows:

$H = V \times I \times t$

= 240 × 3.4× 12

= 9792 J

As the temperature at one side of the plate which is in contact with the strip heater is observed as $T_1 = 95^{O}C$. Therefore, temperature at another side of soleplate which will be in contact with the clothes will be obtained as follows:

$Q = K A (T_1 – T_2) / x$

$9792 = 16.26 \times (1.2 \times 0.4)\ (95 - T_2) / 0.005$

$T_2 = 88.72^{O}C$

**Selection of Strip Heater**

Strip heaters are a simple way of using surface area to transfer heat effectively. Strip heaters are an excellent heating product and can be easily controlled by using a temperature controller. Mounting holes are useful to mount the process heaters securely on almost any surface with terminal extending from the sheath for easy electrical connections.

During testing, the maximum temperature for the pressing clothes is observed as $94^{O}C$. Therefore, the strip heaters temperature is set to be at $95^{O}C$ which can be varied with the help of temperature regulator according to the needed requirement.

Specification of the strip heater is as given below:

Technical Specification:

Watts = 1000 W

Volts = 240 V

Dimensional Specification:

Length = 609 mm

Width = 38 mm

Thickness =10 mm

**Figure 7: Strip Heater.**

**Design of Bevel Gear**

Bevel gears are used to transfer the power of human-hand applied at wheel at the right angle. With the help of bevel gear, the movement of soleplate can be controlled with the help of cam and follower mechanism.

**Figure 8: Bevel Gear.**

### Design of Cam

Cam and follower mechanisms are designed for the smooth operation of the movement of the soleplate. Cam is designed according to the requirement of lift.

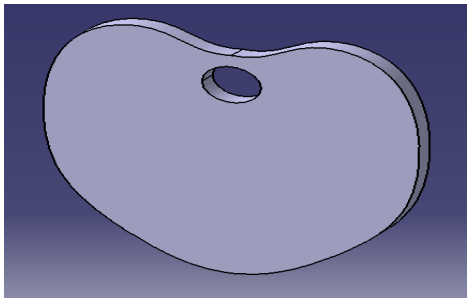

**Figure 9: Cam**

### Design of Roller Follower

Roller follower follows the motion of cam which is attached to the soleplate. Roller follower is always in contact with the cam to avoid the impact of soleplate on the table.

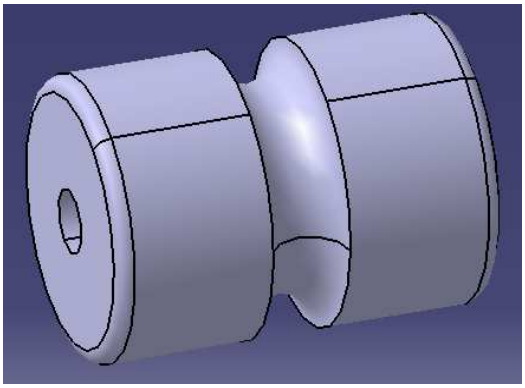

**Figure 10: Roller Follower.**

### Energy Regulator

Energy regulator or controller is a type of switch that allows variable power output of the heating element. The temperature of heating element i.e. strip heater can be varied by using the knob provided on the scale from 10 to 100. The thermostat is

present in the energy regulator as shown in figure 11 contains the inbuilt thermostat which automatically controls the temperature of soleplate. The knob setting is set at a scale of 10 to get the desired temperature.


**Figure 11: Energy Regulator.**

### Location of Strip Heater

Strip heater is arranged in such a manner that the sole plate gets heated uniformly in all the direction to get effective heating. The position of each strip heater is shown in the figure given below:

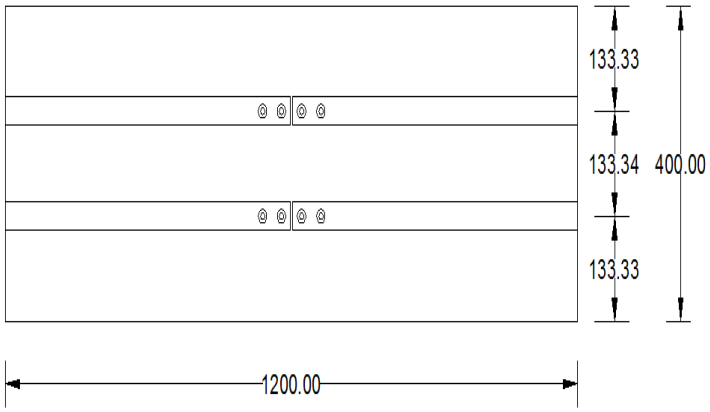


**Figure 12: Position of Strip Heater on Soleplate.**

### Circuit Diagram

The figure shows the circuit diagram for the heating of the strip heater. The temperature of strip heater (H) can be varied according to the requirement with the help of temperature regulator as shown in figure 10 which is connected with the strip heater as shown below:

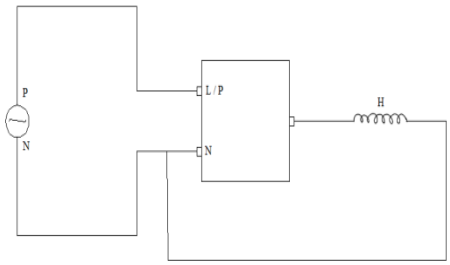


**Figure 13: Circuit Diagram.**

## CONCLUSIONS

The proposed semi-automatic dry ironing machine will help to reduce human efforts & hence fatigue during ironing. Also, this machine will reduce the time required to iron the clothes.

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## AUTHORS PROFILE

**Mr. Shaikh Abdul Malik Abdul Bashir,** ME (Mechanical Design Engineering), This is first publication. Design Engineering, Got 1st Prize for an article for Urdu section in University level Magazine Competition, Stood 1st in TECHNO HUNT organized @ ORCHITECH, a national level Symposium, organized by N.K. Orchid College of Engineering & Technology, Solapur.

**Dr. S .B. Tuljapure** has completed his Ph.D. from Solapur University, Solapur in 2017. He is working as Associate Professor in Mechanical Engineering department at Walchand Institute of Technology, Solapur. He has industrial experience of 6 years and is having teaching experience of more than 13 years. He has guided 12 students for their post graduation dissertation work. He has published 25 research papers in international journals.